Nuclear Regulatory Commission
Exhibit # - AES000001-MA-BD01
Docket # - 07007015
Identified: 01/25/2011

Admitted: 01/25/2011 Withdrawn:
Rejected: Stricken:

Exh. AES000001

AES RESPONSES TO PUBLIC SAFETY QUESTIONS

The Licensing Board noted that all of the safety questions could be answered by both the Nuclear Regulatory Commission ("NRC") Staff and AES, although the Licensing Board explained that at least one party must respond to each question. AES and the NRC Staff have conferred regarding which party is best positioned to respond to the Licensing Board's questions. Based on those discussions, AES is providing a response to the following publicly-available questions: 3(b), 3(c), 8, 11(c), 14, 15, 16, 17, 19, 20(a), 22, 23, and 24. Both AES and the NRC Staff are providing responses to the following publicly-available questions: 3(a), 11(a), 11(b) 18, 20(b), and 27. Below, AES repeats each question, identifies the person(s) providing a response to the question, and responds to the question. Affidavits and statements of qualification for each expert are attached.

ASLB Question 3(a), 3(b), 3(c):

> **(a) The SAR states: "The potential for an external off-site wildland fire was dismissed as a non-credible threat to the facility." The staff's Safety Evaluation Report (SER) lists three independent acceptable sets of qualities (SER at A-24), any one of which could define an event as not credible. Which of these qualities was used to define off-site wildland fire as a non-credible event?**
>
> **(b) The SAR further states: "It is not credible for the rangeland or agricultural vegetation proximate to the EREF site to reach a fire severity that will threaten a process structure or cylinder storage area." Please cite and describe the studies or data on which this assertion is based.**
>
> **(c) Enumerate which structures and systems within the EREF could be adversely impacted by a wildfire associated with high winds, comparable to the July 2010 Idaho National Laboratory (INL) site wildfire, and discuss the consequences to safety of those impacts. For this discussion, please also include the impacts of phenomena commonly associated with severe range fires such as windblown embers and dust storms.**

Response to Question 3(a) (Tyler):[1]

Section 3.1.1 of the Safety Analysis Report ("SAR") (Exh. AES000037) discusses the potential threat to the EREF from an external off-site wildland fire. Based on this evaluation, AES concluded that it is not credible for the rangeland or agricultural vegetation proximate to the EREF site to reach a fire severity that will threaten a process structure or cylinder storage area. In addition to the discussion provided in the SAR, AES is providing additional information in responses 3(b) and 3(c) to support this conclusion.

In Section 3.1.3.2 of the SAR (Exh. AES000037), AES identifies three independent acceptable sets of qualities that could define an event as not credible. The NRC Staff's SER identifies the same three independent acceptable set of qualities that could define an event as not credible. The discussion in Section 3.1.1 of the SAR regarding the specific potential threat posed by a wildfire provides another acceptable approach (*i.e.*, an event-specific assessment) to define this event as not credible — that is, the rangeland or agricultural vegetation proximate to the EREF site cannot reach a fire severity that threatens a process structure or cylinder storage area. Although not explicitly a process deviation, AES's assessment of this specific event is consistent with quality (c) as described in both the SAR and SER. The NRC Staff concurred with this event-specific assessment as described in the SER, Section 7.3.4.1 (Exh. NRC000032).

Response to Question 3(b) (Tyler):

AES analyzed the potential threat for wildland fire and determined that it was not credible. For the cylinder storage area, AES established an Item Relied on for Safety ("IROFS") based on a minimum separation distance for stored cylinders in the Cylinder Receipt and

---

1 *See* Exhibits AES000008 (Tyler Affidavit) and AES000016 (Professional Qualifications).

Shipping Building ("CRSB") from a fire involving a cylinder delivery truck. AES equated the truck fire to an equivalent thirty-minute hydrocarbon pool fire and used a 1-meter setback from stored cylinders as the IROFS basis (IROFS 45). Under that postulated scenario, the fire did not exceed the acceptance criteria for cylinder rupture (<600ºC external cylinder wall temperature for bare cylinders).

For a wildland fire, the distance from a possible source (*i.e.*, vegetation) to the closest cylinder storage pad (30 m) is an order of magnitude greater than that of the hydrocarbon fire exposure. Further, the emissive power of a fire involving area vegetation — low density and low height (mean heights well below 1 m) — is far less than that of a hydrocarbon pool fire. A fire in low density vegetation would also be incapable of maintaining a steady-state emissive exposure for thirty minutes due to insufficient fuel. As a result, AES determined that a threat to the cylinder storage area from a wildland fire is not credible.

AES also determined that a wildland fire is not a credible threat to process structures. All process structures are built of non-combustible materials (*i.e.*, metal panel on metal structural frame and non-combustible insulation) with composite built-up roofing over non-combustible strata (*i.e.*, concrete slab or metal deck with non-combustible insulation). The closest process structure is over 213 m (700 ft) from a source of vegetation/fuel for uncontrolled wildland fire (*i.e.*, at the security fence).

Response to Question 3(c) (Tyler):

There are no structures, systems, or components credited as IROFS that would be affected by conditions comparable to the July 2010 INL site wildfire. IROFS are designed to "fail-safe" upon loss of power (*e.g.*, a wildfire causing a loss of off-site power). The potential consequence of thermal exposure from such a fire was addressed in response to Question 3(b) above. With respect to windblown embers, the exterior material-at-risk (“MAR”) targets are steel cylinders stored on concrete pads which would not be threatened due to the inherent ember size and mass.

As noted above, all process structures are built of non-combustible materials with composite built-up roofing over non-combustible strata. The closest process structure is over 213 m (700 ft) from a source of vegetation/fuel for an uncontrolled wildland fire (*i.e.*, at the security fence). Even if windblown embers are carried to a process structure roof, these are Class A roof assemblies consistent with Building Code requirements and are therefore resilient to burning brands in accordance with ASTM E108, *Standard Test Methods for Fire Tests of Roof Coverings* (Exh. AES000041).

In the event of significant smoke or severe dust storm traversing the site, exterior operations and/or building ventilation systems can be shutdown, as necessary, to minimize occupational exposures and ingress of smoke or dust. The EREF does not rely on plant ventilation systems as IROFS.

ASLB Questions 8:

> **The SER indicates that AES will take steps to ensure that feed material is not contaminated.**
>
> **(a) Please describe the procedures associated with, and the frequency of, the supplier audits that will be conducted?**
>
> **(b) Will feed material be evaluated for contamination (technetium (Tc)-99 or otherwise) at receipt or sometime after receipt, but prior to being used?**

Response to Question 8 (Tilden):[2]

AES will use only licensed UF_6 feed suppliers (U.S. or Canadian) that have a record of compliance with ASTM Standard C787-06, *Standard Specification for Uranium Hexafluoride for Enrichment* (Exh. AES000042). ASTM Standard C787 defines the impurity and uranium isotope limits for "Commercial Natural UF_6" feedstock so that the corresponding enriched uranium is essentially equivalent to enriched uranium made entirely from virgin natural UF_6. Feed suppliers will be required to certify that the feed material provided to AES conforms to ASTM standard C787 and is Commercial Natural UF_6.

AES will also audit activities at feed suppliers' facilities to ensure that the actions required by the ASTM standard are being implemented effectively (*e.g.*, only use cylinders for Commercial Natural UF_6 that have not previously contained reprocessed UF_6 or that have been decontaminated since containing reprocessed UF_6). The frequency of these audits will be based on the results of prior supplier audits, but, in any event, will not exceed once every three years.

In addition, Section 2.3.2 of the EREF Fundamental Nuclear Material Control Plan ("FNMCP") (Exh. AES000039) under "Gaseous UF_6 Sampling" states that feed material is sampled once per feed cylinder prior to feeding the material into the enrichment system to confirm feed assay and compliance with ASTM C787. This statement is not technically accurate and a condition report has been generated under the AES corrective action program to correct this statement. ASTM C787 requires that samples used to determine conformance to the specification are taken when the material is "liquid and homogeneous." As a result, a gaseous UF_6 sample cannot technically demonstrate conformance to this ASTM Standard. The responsibility for demonstrating compliance of feed material with ASTM C787 is normally that

---

2 *See* Exhibits AES000007 (Tilden Affidavit) and AES000015 (Professional Qualifications).

of the feed suppliers. The corresponding commercial requirements for enrichers is to ensure compliance of product material with ASTM C996, *Standard Specification for Uranium Hexafluoride Enriched to Less than 5%* (Exh. AES000043) The FNMCP will be revised to indicate that the purpose of the gas sample is to confirm that the feed material is Commercial Natural UF_6 by ensuring that the level of ^{236}U in this material is within the requirements of this standard. This confirmatory sample, along with the additional controls described above (audits, regulated suppliers with a good performance history) will provide reasonable assurance that feed material is Commercial Natural UF_6.

ASLB Question 11:

> **(a) The Probabilistic Volcanic Hazard Analysis (PVHA) accepted by the staff used a volcanic event recurrence rate developed by Hackett (2002) for the entire axial volcanic zone. Explain why the close proximity of the 5.2 ka Hell's Half Acre volcanic field to the EREF site does not demonstrate that the probability of an eruption in this part of the axial volcanic zone is greater than the value determined by the spatially homogeneous model.**
>
> **(b) The PVHA concluded, and the staff accepted, that the annual probability of lava inundation at the EREF site is 5 x 10E-6, which corresponds to a 200,000 year site-inundation recurrence interval. In contrast, Champion (2002) (cited in the reference list in Appendix D of the application), gives inundation recurrence values of 40,000 years for the area of the INL closest to the EREF site. Please explain why the two estimates are so different and why it is appropriate to accept the longer inundation recurrence interval in the PVHA.**
>
> **(c) Discuss what preparations and procedures would be undertaken to minimize the potential release of hazardous materials if precursor events, such as seismic activity or volcanic gas emissions, indicated an imminent eruption of basaltic lava that could threaten the EREF.**

Response to Question 11 (Hackett):[3]

As part of the response to Question 11, AES has analyzed several alternate hypothetical scenarios, expressed as calculations of inundation probabilities for the purpose of comparing these scenarios to the approach taken in the EREF SAR. The alternate calculations, which are discussed below, address the significance of latest Pleistocene and Holocene volcanism in the vicinity of the EREF site. The alternate calculations demonstrate that the approach taken in the EREF application is appropriately conservative.

Response to Question 11(a) (Hackett):

Approximately ten volcanic events are recorded in the surface geology within about a 12-km radius of the EREF site. These volcanic events are marked by individual pit craters, spatter mounds, clusters of such vent features, and surrounding lava fields. One of these events is represented by the 5.2 ka Hell's Half Acre ("HHA") lava field, one of the largest lava fields on the Eastern Snake River Plain ("ESRP"), which erupted from vents about 7 km south of the EREF site. Lava flowed mostly to the south, but about six percent of the lava flowed north of the vent area, to within about 2 km of the EREF site. The other approximately nine volcanic events occurred during eruptive periods Qbd and Qbc of Kuntz et al. (1994) (Exh. AE000050), and have estimated and measured ages ranging from 730 ka to 200 ka.

The EREF is sited on 316 +/- 75 ka lava flows from Kettle Butte, a basaltic shield volcano about 5 km to the east. The probability of an eruption in this part of the axial volcanic zone ("AVZ") is not greater than the value determined by the spatially homogeneous model, for the following reasons:

---

[3] *See* Exhibits AES000002 (Hackett Affidavit) and AES000010 (Professional Qualifications).

- For the entire axial volcanic zone, Hackett et al (2002, Table 3) (Exh. AES000049) estimate that a total of about 45 volcanic events are recorded in the surface geology, of which 4 lava fields are of Holocene or latest Pleistocene age (< 13.3 ka). Thus, Holocene and latest Pleistocene events account for less than ten percent of the total volcanic events in the axial volcanic zone. In the vicinity of the EREF site, about ten volcanic events are recorded, one of which is the 5.2 ka HHA lava field. Therefore, there is no appreciable difference between the proportion of latest Pleistocene and Holocene volcanic events to total events for the entire axial volcanic zone, or in that proportion within the area near the EREF site. Stated differently, there is no greater proportion of latest Pleistocene and Holocene volcanism to total volcanism in the vicinity of the EREF site than there is for the axial volcanic zone generally.

- The assertion that the axial volcanic zone is spatially homogeneous is supported by visual examination of the volcanic vent locations in the AVZ generally, as well as in the vicinity of the EREF site. We state this as part of our response because the question may include an inquiry into the spatial homogeneity of vents in the AVZ. If the spatial density of volcanic vents (and the events they record) were not generally uniform across the AVZ in the vicinity of the EREF site; specifically, if there was a significant increase in vent spatial density, particularly for the youngest volcanism near the EREF site, then this might indicate an increased probability of future eruptions near the EREF site. Examination of the geologic map (Kuntz et al., 1994) (Exh. AE000050) shows that this is not the case.

- If there is any spatial pattern to the vent locations and lava fields of the youngest basaltic map units of the AVZ (Kuntz, et al., 1994; units Qbb and Qba, all being <200 ka in age), it is the tendency for these eruptions to have occurred along the broad topographic apex of the AVZ and from vents to the south of that apex. As a result, most of the lavas from these vents have flowed south, away from the topographic crest of the AVZ and away from the EREF site. The most prominent example is the HHA lava field. Holocene and late Pleistocene volcanism in the AVZ (including the 165 ka Taber Butte lava field) has spanned much of the southwest-to-northeast length of the axial volcanic zone in its central and southern parts, and is not strongly spatially clustered in any part of the AVZ. Based on the general spatial pattern of latest Pleistocene and Holocene volcanism, it can therefore be concluded that future volcanism in the AVZ is more likely to erupt from vents along the central topographic axis or on the southern flank of the AVZ, and that these lavas are likely to flow southward away from the broad topographic crest of the AVZ and away from the EREF site. However, in the EREF PVHA we do not make this conclusion or take credit for it.

- Basaltic volcanoes of the ESRP are almost entirely monogenetic, producing lava fields and small shield volcanoes in geologically short periods of time and from single batches of magma. Although there is some tendency for vents and fissures to cluster into cogenetic (co-erupted) groups at the scale of a few square kilometers, these features are rather uniformly dispersed across the AVZ. The location of a specific monogenetic volcano such as the HHA lava field, or any other one for that matter, is therefore is not a good predictor of the specific location of future volcanism on the ESRP.

A hypothetical scenario, expressed as a calculation of inundation probability, is presented below to support the response to Question 11(a).

Analysis 3 (numbered sequentially after the two analyses presented in the PVHA): Calculate the inundation probability for a hypothetical eruption at a random site on the AVZ, using only the characteristics of latest Pleistocene and Holocene volcanism in the axial volcanic zone as a basis for the calculation. This is a variation of existing Analysis 2 in the docketed PVHA, emphasizing most recent volcanism in the axial volcanic zone. It derives a hypothetical inundation probability given a late Pleistocene/ Holocene eruption of average area, at a random location in the AVZ. This hypothetical scenario by itself is not a credible scheme for future lava inundation, because there are many other volcanic events in the AVZ that must also be included (and have been included) in the PVHA.

Three events in the past 13.3 ka: N and S Robbers lava fields together are one event (8 km2); Cerro Grande lava field is one event (175 km2); Hells Half Acre is one event (400 km2). This gives a 2.3 x 10E-04 per yr (4,400 yr event recurrence).

Although only three in number, together these three most recent lava fields are a microcosm of a "small-medium-large" areal distribution for lava fields and shield volcanoes for the entire ESRP. The arithmetic average of the three areas is 194 km^2, which is about the same area as "the average ESRP shield volcano" used later in Analysis 4 in terms of event magnitude.

(2.3 x 10E-04 event recurrence) x (area of event/area of AVZ) =

(2.3 x 10E-04 event recurrence) x (194/1500) =

3 x 10E-05 per yr (33,300 yr inundation recurrence)

Discussion: The calculated inundation recurrence (33,300 yrs) is about three times the inundation recurrence calculated later in this response (Analysis 4) for all events in the AVZ (115,000 yrs). This is not a significant justification for overweighting latest Pleistocene/Holocene events relative to all other events in the AVZ over the time period of interest (the past 730 ka). In the PVHA, a homogeneous temporal model of volcanism is adopted and most recent volcanism receives no special treatment because event magnitude and frequency are not substantially different from those of longer time periods across the entire AVZ.

Response to Question 11(b) (Hackett):

AES does not dispute the methodology or robustness of the results reported in Champion et al. (2002) (Exh. AES000047). An important finding of Champion et al. (2002), which is also reflected in the surface geology of the INL area and corroborated in other papers published in the same volume (Link and Mink, 2002) (Exh. AES000051), is that basaltic volcanism becomes younger and more frequent from the NW margin of the ESRP toward the AVZ, the AVZ being a long-lived constructional volcanic highland that separates areas of relative ESRP subsidence to the north and south. Although the EREF PVHA and the borehole investigation of Champion et al. (2002) both report inundation probabilities, the two investigations are difficult to explain comparatively for several general reasons, including the fact that the data sets and methodologies on which conclusions are based are different, the respective regions of interest are different, and the EREF PVHA assumes a homogeneous temporal model of volcanism. Details on these differences are provided below:

- **The data sets and methodologies differ.** The EREF PVHA is based on surface geology as published on geologic maps of the INL area, chiefly Kuntz et al. (1994) (Exh. AES000050). The EREF PVHA, therefore, emphasizes most-recent volcanism in the INL area, specifically volcanism of the AVZ in which the EREF site is situated, and relies on measurements and interpretations of surface outcrops to estimate the frequency, location and magnitude of future volcanism. By contrast, Champion et al. (2002) (Exh. AES000047) addresses the issue differently: a record of volcanism derived from measurements on subsurface rock cores obtained from about twenty boreholes of the south-central INL. In both studies (PVHA and Champion et al. (2002)), interpretation of the volcanic products (chiefly lava flows and co-erupted groups of lava flows), together with paleomagnetic and radiometric age determinations, form the basis for estimating volcanic recurrence in the regions of interest.

  One might expect these similarities to yield similar conclusions about the recurrence rate of lava inundation, but in combination with the other reasons enumerated later, a specific outcome of having "different data sets" is that event definition is likely to differ substantially, and event definition is fundamental for calculating volcanic recurrence. In the subsurface, lava flows are common but actual vents are rarely intersected, so lava flows form the basis of event definition. In surficial analysis, the locations and ages of volcanic vents, in addition to lava flows erupted from those vents, are essential for developing frequency and magnitude estimates in PVHA. For example, measurements of surficial lava flows are important in PVHA for evaluating event magnitude (e.g., the lengths and areas of lava flows), and these parameters are less confidently determined from borehole data.

When a lava flow is intersected in a borehole, it is an unavoidable conclusion (barring tectonic or glacial transport, etc.) that the location at depth was inundated by lava, and the methods used by Champion et al. (2002) are appropriate for estimating recurrence rates for lava inundation at a borehole site, and for constructing contour maps showing subregional inundation rates from multiple boreholes (Figure 20 of Champion et al., 2002). The site-specific EREF PVHA approach differs substantially: the starting point is the estimated volcanic event-recurrence (<u>not</u> an inundation recurrence) for the volcanic source zone containing the EREF site. But not all lava flow eruptions within the AVZ will reach the EREF site, and therefore sequences of conditional probabilities are developed, based on the statistics of mapped lava flow lengths and areas measured from the INL region, and sometimes topographic analysis. The objective is to calculate a site-specific inundation probability for the EREF. This calculation can be strengthened with borehole data, but a site-specific inundation probability cannot be derived solely from borehole data.

Thus, it would be inappropriate to consider one approach inherently correct and defensible, the other not. Multiple boreholes and decades of borehole measurements are not available near the EREF site. Instead, there are plenty of outcrops and high-quality geologic map data (Kuntz, et al., 1994). This information was used to construct a simple, logical probabilistic analysis that should be evaluated primarily on its own merits, rather than comparatively. The strong points of the PVHA analysis are that it is simple, logical, and probabilistic in its approach, and emphasizes recent volcanism as revealed by the surficial geology of the Axial Volcanic Zone in which the EREF is situated.

- **<u>The regions of interest are adjacent, but differ in important ways.</u>** The borehole investigation of Champion et al. (2002) lies mainly within the Big Lost trough, an underfilled tectonic basin that has existed for at least the past 2.5 Ma, which contains clastic sedimentary units interbedded with lava flows erupted from several nearby volcanic rift zones (Geslin et al., 2002) (Exh. AES000048). The complex volcanic-sedimentary architecture of the basin fill reflects the development of several volcanic zones along the basin margins, subsidence of the area, and fluvial sedimentation. Thus, the borehole investigation of Champion et al. (2002) presents a record of basaltic volcanism from a number of source zones, including but not limited to the AVZ.

The Axial Volcanic Zone is a long-lived, northeast-trending constructional volcanic highland of the central ESRP, forming the southern boundary of the Big Lost Trough. Because the EREF is situated within the AVZ, it is this volcanic source zone that is most relevant to the EREF PVHA, and other older and more distant volcanic source zones (such as the northwest-trending rift zones bounding the Big Lost Trough) are less relevant.

Champion et al. (2002) present borehole data showing that lava accumulation rates, basalt lava-flow thicknesses, and average recurrence intervals of basalt lava inundation all increase toward the southeast, toward the AVZ. These observations are consistent with the 16,000-year recurrence interval for volcanic events of the AVZ (Hackett et al., 2002) (Exh. AES000049), this being the shortest recurrence of all volcanic source zones of the INL area, as used in the EREF PVHA.

- **Concerning the homogeneous temporal model of the EREF PVHA,** the ages of lava flows from southern INL boreholes (Champion et al., 2002) range from about 780 ka to 77 ka, but few boreholes contain lava younger than about 200 ka. Most surface basalt lava flows of the AVZ are also younger than 730 ka (within the Brunhes Normal Polarity Chron). Thus, the time periods of volcanism overlap for the southern INL boreholes and for outcrops of the AVZ, but few boreholes contain lavas younger than about 200 ka, leading Champion et al. (2002, p. 189) to conclude that "most of the Eastern Snake River Plain at or near the INEEL underwent a hiatus in lava flow accumulation for the past 200 ka."

  The AVZ also underwent a period of decreased volcanism during the past 200 ka, but not a complete hiatus. At least 5 lava fields erupted in the central and eastern AVZ during this period (Kuntz et al., 1994): Taber Butte (165 ka), Cerro Grande (13.4 ka), North and South Robbers (12 ka), and Hells Half Acre (5.2 ka) are examples. Additional lava fields with estimated ages between 15-200 ka also occur in the western AVZ near Big Southern Butte. Thus, the surficial geology of the AVZ records more recent volcanism (latest Pleistocene to Holocene) than the topmost lava flows in boreholes of the southern INL, and this more recent volcanism has been included in the EREF PVHA.

  The homogeneous temporal model of the EREF PVHA does not account for the apparent waning of volcanism during the past 200 ka in the INL region as reported by Champion et al. (2002). In this regard, the EREF PVHA is conservative because it carries throughout the time

> period of interest an event recurrence (16,000 yrs) that reflects volcanism that occurred from about 5 ka to 730 ka.
>
> A specific implication of using a homogeneous temporal model in a setting where volcanism has waned during the past 200 ka of a 730 ka period of interest, is that the model will produce a shorter recurrence for younger volcanism; shorter than the recurrence calculated solely on the basis of younger volcanism. An illustration is the occurrence of 4 or 5 events in the central and eastern AVZ during the past 165,000 years, giving an event recurrence interval of about 33,000 to 42,000 years. This event recurrence is more than twice as long as the 16,000-year recurrence interval that is uniformly applied to the AVZ in the homogeneous temporal model of the AVZ used in the EREF PVHA.

A hypothetical scenario, expressed as a calculation of inundation probability, is presented below to support the response to Question 11(b).

Analysis 4: This hypothetical scenario is a variation of existing PVHA Analysis 2, but uses "the area of an average-sized ESRP shield volcano" for the event magnitude rather than the lava-flow statistics of Hackett et al. (2002) used in existing Analysis 2. Existing Analyses 1 and 2 are retained as part of a range of calculated inundation probabilities, with those calculations representing the eruption of a few lava flows of average size as measured on geologic maps, but not the eruption of an entire shield volcano of typical size. Analysis 4 is based on what we consider to be the typical, representative volcanic event of the ESRP during the past million years or more: the eruption of a basaltic shield volcano composed of many lava flows.

Parameter derivation: The volumes of Quaternary ESRP shield volcanoes are 5 plus or minus 3 cubic km (Champion et al., 2002, and other references cited therein). The Hells Half Acre lava field (6 cubic km), the Wapi shield volcano of the southern Great Rift (6 cubic km) and the Cerro Grande lava field of the south-central axial volcanic zone (2.3 cubic km) are examples of such features (volume estimates from Kuntz, et al., 1992). The thickness of lava flows per volcanic event, erupted from shield volcanoes and lava fields within or near the axial volcanic zone, is 24 m (Champion et al., 2002, Fig. 19). Thus the average ESRP shield volcano as defined in this calculation is 5 cubic km in volume, averages 24 m in thickness of lava, and therefore covers about 208 sq km.

Results for a 5 cubic km basaltic shield volcano erupted at a random location within the axial volcanic zone are as follows:

> (Event recurrence of AVZ) x (area fraction of AVZ covered by event) =
>
> (Event recurrence of AVZ) x (208/1500) =
>
> (6.2 x 10E-05 per yr) x (0.14) = 8.7 x 10E-06 per yr (115,000 year inundation recurrence)

Discussion: Analysis 4 reflects a hypothetical scenario that captures with conservatism the expected characteristics of future volcanism in the AVZ (the event definition involves voluminous basaltic volcanism and the event magnitude is quite large). This scenario results in about half the recurrence (twice the frequency) as compared with Analysis 2 in the docketed PVHA because the event magnitude, as expressed by area of lava, has been about doubled in this calculation relative to Analysis 2. The Analysis 4 hypothesis represents a conservative event magnitude for growth of a future shield volcano, which results in a 115,000 year inundation recurrence estimate (on the order of 10E-05 per year).

The inundation probability of Analysis 4 is about a factor of 3 longer than the 40,000 year recurrence estimated by Champion et al. (2002, Fig. 20) for the AVZ using borehole data. This is acceptable agreement among estimates, given the inherent differences in methodologies, the different regions of interest and the implications of the homogeneous temporal model used in the EREF PVHA.

In summary, all inundation recurrences, calculated herein and in the docketed PVHA, using defensible and credible scenarios, are on the order of 10E-05 per year or less (on the order of 100,000 years or longer). This conclusion is appropriate because the methodology is simple, logical, and appropriately conservative, is based on surface geology near the EREF site, considers the time period of volcanism represented by mapped vents in the AVZ and near the EREF site, and is consistent with the results of other probabilistic analyses based on the surficial geology of the southern INL area.

Response to Question 11(c) (Hackett, Harper):[4]

Hackett et al. (2002, p 477 and 480) (Exh. AES000049) discuss the mitigation of basalt lava flow inundation and cite references on the subject. Most lava flows are expected to give at least a few weeks of advanced warning, depending on magma ascent rate and proximity of the eruptive vents, allowing time for mitigation measures. For the EREF, the most effective mitigation would be the construction of rock-rubble berms around critical portions of the facility (once it has been determined that lava is headed toward the facility). Such berms could be constructed of rock and soil excavated from the nearby land surface. Blong (1984, p. 193) (Exh. AES000046) reports numerous observations showing that lava flows with low yield strengths (*i.e.*, basaltic pahoehoe flows) can be diverted by resistant structures, if properly constructed. Additional mitigation measures would also include placing the facility in a safe mode and consolidating storage areas for material that could be released. Figure 1 (attached) also shows that the topography around the EREF is beneficial and provides substantial natural barriers to inundation at the site. With the site elevation at 5201 feet, the terrain would divert lava flows of up to 8-10 m thick. The PVHA does not explicitly account for this topographical protection or take credit for its effects.

ASLB Question 14:

> **The SER indicates that the AES President is responsible for the "design, quality assurance, construction, operation, and decommissioning of the EREF." Additionally, the SER states (at 1-8) that "[a]ny safety decision related to the operation of the facility will be made by the President of AES." What influence, both long-term and day-to-day, will AES's parent corporation, AREVA NC Inc., and AREVA NC SA and AREVA SA, the parent corporations of AREVA NC Inc., have over these aspects of AES decisionmaking?**

Response to Question 14 (Shakir):[5]

The AES President is appointed as the top executive of AES LLC. In his role, the AES President reports to the AES Management Committee. The AES Management Committee consists of members representing AES's shareholders, AREVA NC Inc. and AREVA NC SA, the parent corporations of AREVA NC Inc. The AES Management Committee oversees

---

4 *See* Exhibits AES000003 (Harper Affidavit) and AES000011 (Professional Qualifications).

5 *See* Exhibits AES000005 (Shakir Affidavit) and AES000013 (Professional Qualifications).

business and commercial activities, financial performance, organization, and other key commercial, industrial, and financial strategies. The AES Management Committee has no influence, either long-term or day to day, over safety or quality assurance in the design, construction, operation and decommissioning of the EREF. Those responsibilities and decision-making authority reside solely with the AES President.

ASLB Question 15:

> **Please explain why the qualifications of a bachelor of science degree with four years of nuclear experience and one year of direct experience are sufficient for the Nuclear Criticality Safety Manager.**

Response to Question 15 (Tilden):

The qualifications for the Nuclear Criticality Safety Manager establish the experience level necessary for managing a technical program and ensuring compliance with applicable procedures, prioritizing work assignments, assigning qualified personnel to appropriate tasks, and undertaking other management activities. The Nuclear Criticality Safety Manager is responsible for performing oversight of the criticality safety program but would not actually perform a nuclear criticality safety evaluation or serve as the independent reviewer of such an evaluation unless the manager had completed the specific training program for a Criticality Safety Engineer (as described in the SAR Section 2.2.4.AA) (Exh. AES000037).

ASLB Question 16:

> **(a) The SER indicates that the Quality Assurance (QA), Environmental Health Safety and Licensing, Safety, Security and Emergency Preparedness, and Safeguards Managers are "independent" from the Operations Managers. What specific processes and procedures will be established to ensure that these managers are independent so as to encourage candid discussion of safety issues?**
>
> **(b) The SER also indicates that incident investigation teams will be "assured of no retaliation for participating in investigations." What**

processes and procedures will be in place to ensure they will not be retaliated against?

Response to Question 16(a) (Tilden):

The organizational structure described in the SAR Section 2, the Quality Assurance Program Description ("QAPD"), the Fundamental Nuclear Materials Control Plan ("FNMCP"), the Emergency Plan, and the Physical Security Plan establish a reporting chain of command for these positions that is separate and distinct from the reporting chain of command for the two managers whose principal responsibility is related to production (Operations Manager and Uranium Management Manager). The Quality Assurance Manager and Environmental Health, Safety and Licensing Manager both report directly to the Plant Manager and therefore have direct access to the Plant Manager at all times. And, as described in SAR Sections 2.2.1.L and 2.2.1.N (Exh. AES000037), the Safety, Security and Emergency Preparedness Manager and the Safeguards Manager both have direct access to the Plant Manager in matters involving physical protection of the facility or classified matter and matters involving safeguards, respectively. Because of the independent reporting chain of command and direct access to the Plant Manager, the Quality Assurance, Environmental Health Safety and Licensing, Safety, Security and Emergency Preparedness, and Safeguards Managers are "independent" managers whose primary responsibilities relate to safety and security (rather than production).

Response to Question 16(b) (Tilden):

Regardless of title or formal responsibilities, all plant personnel are encouraged to engage in candid discussions of safety issues and to raise safety concerns. Project personnel are provided familiarization training regarding the need for a Safety Conscious Work Environment ("SCWE") during initial project orientation. Under 10 C.F.R. § 70.7, a SCWE must be maintained during both the construction and operations phases of the project. As part of a

SCWE, all personnel are assured that there will be no retaliation for raising safety issues or concerns — whether as part of an investigation team or acting as an individual. In addition, other plant programs and processes (*e.g.*, the corrective action program and the Employee Concerns Program) provide alternate methods for employees to raise concerns or report instances in which concerns were not appropriately addressed by management or others. Such reports are investigated and addressed in a timely manner.

ASLB Question 17:

> **The SER indicates the organizational independence of the Radiation Protection/Chemistry Manager and line managers should be established. Which of these two managers, or what other manager, has precedence of authority in accident situations?**

Response to Question 17 (Tilden):

During an accident, line management is responsible for characterizing the event and determining if the event should be categorized as an emergency. If the event is categorized as an emergency, the Emergency Plan is activated and the plant emergency director becomes responsible for the facility response. If the accident is not an emergency event, then line management (on shift Production Supervisor) is responsible for mitigation and recovery.

Depending on the nature of the event, nuclear criticality safety, radiation protection, industrial hygiene, occupational safety, or security organizations may be consulted to determine the impact of the accident on plant safety or production. Any of these organizations (through the responsible manager) may recommend actions to the Production Supervisor, up to and including stopping operations. If there is disagreement among those organizations as to the appropriate response or if a relevant expert does not believe that adequate actions are being taken to control the event, the Environmental, Health, Safety and Licensing Manager is authorized to stop production independent of line management (as described in SAR Section 2.2.1.D).

ASLB Question 18:

> **In its SAR at section 4.2, AES has committed to apply "as low as reasonably achievable" (ALARA) principles to EREF personnel. See SAR at 4.2-1 ("Annual doses to individual personnel are maintained ALARA. In addition, the annual collective dose to personnel . . . is maintained ALARA."). AES then sets a 1 rem/year administrative limit in Table 4.1-1 of the EREF SAR, which represents twenty percent of the annual NRC limit of 5 rem/year given in 10 C.F.R. § 20.1201. AES states that this limit is consistent with ALARA and the staff appears to remain silent on this point. See SAR at 4.1-1 ("This [administrative limit] provides assurance that legal radiation exposure limits are not exceeded and that the ALARA principle is emphasized."); SER at 4-15. Given AES's additional explanation that 1 rem/year bounds "operating experience of similar facilities in Europe," including the Urenco Capenhurst site (maximum annual dose of 341 mrem in 2007), and its statement that "since additional exposures occur at the Capenhurst Site, it is likely that the exposures at the EREF will be lower," SAR at 4.1-1, why is 1 rem/year an appropriate administrative limit for external exposure consistent with ALARA?**

Response to Question 18 (Strum):[6]

The 1 rem/year Total Effective Dose Equivalent ("TEDE") administrative dose limit is intended to cap individual doses well below the regulatory limit of 5 rem/year. This provides for operational flexibility to address abnormal exposure conditions, if such conditions were to occur, while still maintaining individual doses well below regulatory limits. The administrative dose limit effectively lowers the operational dose limit to a small fraction (20%) of the regulatory limit. This is consistent with the objective of the Radiation Protection Program design, which is to minimize all radiation exposures to As Low As Reasonably Achievable ("ALARA") below all limits (both administrative and regulatory).

The administrative limit (1 rem/year) is not treated as ALARA itself. Operational history at the Capenhurst facility indicates that both the annual maximum and average worker

---

6 *See* Exhibits AES000006 (Strum Affidavit) and AES000014 (Professional Qualifications).

doses (341 mrem/year and 44 mrem/year, respectively in 2007) are well below the 1 rem/year administrative criteria. The EREF commitment to an ALARA program (EREF SAR Section 4.2) (Exh. AES000037) will implement comprehensive operational controls by procedure and design features to ensure that all doses are reduced and maintained to the lowest extent practical (*i.e.*, below the 1 rem/year limit).

ASLB Question 19:

> **The SER indicates the Full Tails Cylinder Storage Pad (FTCSP) has a capacity to hold 33,638 cylinders that would all require visual inspection annually for damage or surface coating defects.**
>
> **(a) How will visual inspection (VI) of tail cylinders be conducted?**
>
> **(b) On an annual basis, how many man-hours are anticipated to be dedicated to tail cylinders VI?**

Response to Question 19(a) (Tilden):

Visual inspection of tails cylinder will be conducted by trained cylinder operations personnel. They will follow the process for routine cylinder inspections described in ANSI N14.1, *Uranium Hexafluoride - Packaging for Transport*, Section 6.3.1 and Appendix F (Exh. AES000044), and in USEC-651, *Uranium Hexafluoride: A Manual of Good Handling Practices*, Section 3.3.1 and Figures 1 and 2 (Exh. AES000045).

Response to Question 19(b) (Tilden):

Based on experience from other facilities, each cylinder inspection is performed by a two-person team. On average, each inspection takes no more than 30 minutes. Based on these assumptions, there will be about 33,600 hours of annual cylinder inspection work by the end of facility life. Over time, AES anticipates that it will be able to develop sufficient operational experience and a history of inspection results to reassess the inspection frequency. AES expects that this data may reduce inspection requirements by a factor of four well before the end of facility life. If DOE accepts depleted uranium cylinders for deconversion prior to the end of plant life or if commercial deconversion facilities become available, the projected man-hours for cylinder inspections would decrease accordingly.

ASLB Question 20:

> **In the SER, the staff indicates that AES "has assumed that DOE will take title and possession of DU for disposal." Currently, the staff is considering an application for a commercial depleted uranium deconversion facility located near Hobbs, New Mexico. Assuming that deconversion facility is licensed, constructed, and begins operating:**
>
> **(a) Has AES reached any determination that it will not utilize that facility for processing the depleted uranium produced at the Eagle Rock facility?**
>
> **(b) If AES wished to use that deconversion facility in the future, would that require any changes/amendments to any Part 70 license that might be issued in this proceeding?**

Response to Question 20(a) (Tilden):

AES has not made any determinations regarding possible use of the proposed International Isotopes Fluorine Products ("IIFP") commercial deconversion facility for processing depleted UF_6 produced at the EREF. Section 3113(a) of the USEC Privatization Act, 42 U.S.C. § 2297h-11(a), requires DOE to accept depleted uranium for disposal upon request of the operator of a uranium enrichment facility. Transfer of the depleted UF_6 generated by the EREF to DOE for disposal is AES's current strategy. An evaluation of alternate approaches and any decision related to other commercial opportunities will be made based on facility availability and economics.

Response to Question 20(b) (Kay):[7]

Based on AES's current understanding of the IIFP facility, a license amendment would not be necessary in order for AES to use the IIFP facility. Nevertheless, if AES decides to consider using the IIFP facility in the future, AES would evaluate the use of the IIFP facility using the process required by 10 C.F.R. § 70.72 before making a final determination.

ASLB Question 22:

> **Given the audit participation requirements to obtain QA Program certification, how will AES staff its initial audit teams?**

Response to Question 22 (Weiner):

The qualification requirements for Lead Auditors at the EREF are standard requirements used throughout the nuclear industry. AES will utilize two methods to obtain personnel with the necessary experience and qualifications to be certified as Lead Auditors in accordance with the AES QAPD Requirements:

- <u>Method 1</u>. New hires that already have the necessary experience and prior certification as Lead Auditors to satisfy AES qualification requirements. In conjunction with AES-specific training, these individuals could be certified in accordance with AES Procedure QA-02-03-01, "Lead Auditor Training and Certification" (Exh. AES000052).
- <u>Method 2</u>. AES uses Certified Lead Auditors from other AREVA companies or subsidiaries under the conditions stipulated in Paragraph 5.5 of QA-02-03-01, which is reproduced below:

---

7 *See* Exhibits AES000004 (Kay Affidavit) and AES000012 (Professional Qualifications).

5.5 Third Party Auditor Certification

The Quality Assurance Manager or designee may qualify individuals (such as independent third party auditors or lead auditors) as lead auditors under the AES QAPD based on a review of current qualifications, experience and training through other companies or agencies. The individual would not require an examination under the requirements of this procedure. In this case, the Quality Assurance Manager or designee must review and accept the following:

- Resume of individuals education and work experience.
- Evidence of lead auditor training.
- Evidence of current and active Lead Auditor certification.
- Evidence of recent nuclear QA audits performed within the past year.

The individual must also be trained either formally or through self reading to the AES QAPD and applicable AES procedures used for auditing under the requirements of the QAPD. The Quality Assurance Manager or designee shall document approval of the individual's qualifications, and their training, and then certify the individual under this procedure.

Certified Lead Auditors from other AREVA companies or subsidiaries may be used provided the Quality Assurance Manager verifies that they are currently certified with their supervisor, and provided that the certification process meets requirements similar to those specified within this procedure. The individual must also be trained either formally or through self reading to the AES QAPD and applicable AES procedures used for auditing under the requirements of the QAPD. A copy of the AREVA Lead Auditor Certification will be obtained for retention by AES.

Through the above methods, AES will be able to initially staff the QA Organization with a sufficient number of Certified Lead Auditors.

ASLB Question 23:

> **How will AES establish guidance for classifying occurrences as "abnormal" for the purpose of conducting incident investigations so as to avoid normalizing off-normal occurrences?**

Response to Question 23 (Tilden):

AES will establish and clearly communicate the criteria for determining when an abnormal event investigation is necessary in a Conduct of Operations procedure. The criteria will be based on nuclear industry guidance documents, such as the Institute of Nuclear Power Operations' guidance in INPO 01-002, *Guidelines for the Conduct of Operations at Nuclear Power Stations* (Exh. AES000055). Specific examples of criteria for classifying occurrences as "abnormal" that have been derived from the INPO guidelines include:

- The event is required to be reported to a regulatory agency.
- Plant system performance is unusual or unexplained.
- An unplanned shutdown or significant loss of separative work occurs.
- Procedural violations or personnel errors occur that caused or could have caused serious personnel injury or equipment damage or that could have affected the availability or reliability of IROFS.
- Equipment failure occurs to equipment within the IROFS boundary.
- A control relied on in a nuclear criticality safety evaluation was violated or its effectiveness could not be confirmed.
- Radiological or chemical exposure limits are exceeded or radioactive material is lost.
- Repetitive problems occur.
- A department head or the plant safety review committee deems an investigation is appropriate.

ASLB Question 24:

> **(a) What criteria will the QA Manager use to assess whether corrective actions are implemented in a timely fashion?**
>
> **(b) Under what criteria will the QA Manager be able to order a work stoppage?**

Response to Question 24(a) (Weiner):[8]

AREVA has established a Key Performance Indicator ("KPI") for Significance Level 1 & 2 condition reports being open no longer than 180 days. AES has adopted this KPI. Starting in October 2010, AES began providing monthly reports on this KPI to the AES Management Team. Prior to October 2010, the status of condition reports (open, closed, and overdue) was included in the monthly report to AES Management.

AES has also issued Procedure QA-16-03-001, "Corrective Action" (Exh. AES000053). The goal of the procedure is to ensure that adverse conditions are identified and resolved in a timely manner so as to prevent recurrence. Within this procedure, AES established timelines for the initiation, evaluation, assignment, and closure of corrective actions. QA-16-03-001 also establishes responsibilities for the QA Manager and Functional Area Managers ("FAMs") regarding the processing of condition reports based on their significance levels. For Significance Level 1 condition reports, the QA Manager is the Chairperson of the Corrective Action Committee ("CAC"). The CAC is responsible for concurring with recommended corrective actions and due dates for implementation. For Significance Level 2 condition reports, the FAM establishes applicable due dates, while the QA Manager has overall responsibility to monitor compliance through audits and surveillances.

---

8 *See* Exhibits AES000009 (Weiner Affidavit) and AES000017 (Professional Qualifications).

Response to Question 24(b) (Weiner):

AES has issued Procedure QA-16-03-002, "Stop Work" (Exh. AES000054). This procedure establishes the method used by AES to stop work when significant conditions adverse to quality are observed and it is otherwise prudent to stop work. The procedure scope indicates that QA-16-03-002 applies to any work activities that, if allowed to continue, could compromise the quality of an item or service, render the quality of an item or service as indeterminate, compound an existing condition adverse to quality, or result in potential injury or exposure to the public, personnel, or environment. QA-16-03-002 also permits resumption of work when sufficient corrective actions have been accomplished and/or adequate measures are put in place to control further activities.

The QA Manager, or designee, has overall responsibility and authority to issue and close out a Stop Work Order ("SWO"). This responsibility includes approval of corrective actions to correct any deficiency and prevent recurrence. The QA Manager is also authorized to close out SWOs, thus allowing work to resume (subject to any corrective actions). FAMs are responsible for stopping work as described in the SWO. FAMs are also responsible for acknowledging the basis for SWOs and implementing the associated corrective actions. Individual employees are responsible for contacting QA when a situation warrants an evaluation and there is potential need to issue a SWO.

The following are examples of situations or conditions where a SWO may be appropriate:

- When continuation of activities could result in significant deficiencies that would negatively affect nuclear safety.
- When work being conducted is such that the quality of work or the product of that work is unacceptable.
- When the quality of the work is indeterminate.

- When working conditions are such that continuing work could result in an immediate hazard to the public, the environment, or working personnel.
- When activities pose a potential for injury or exposure to the public, personnel, or the environment.

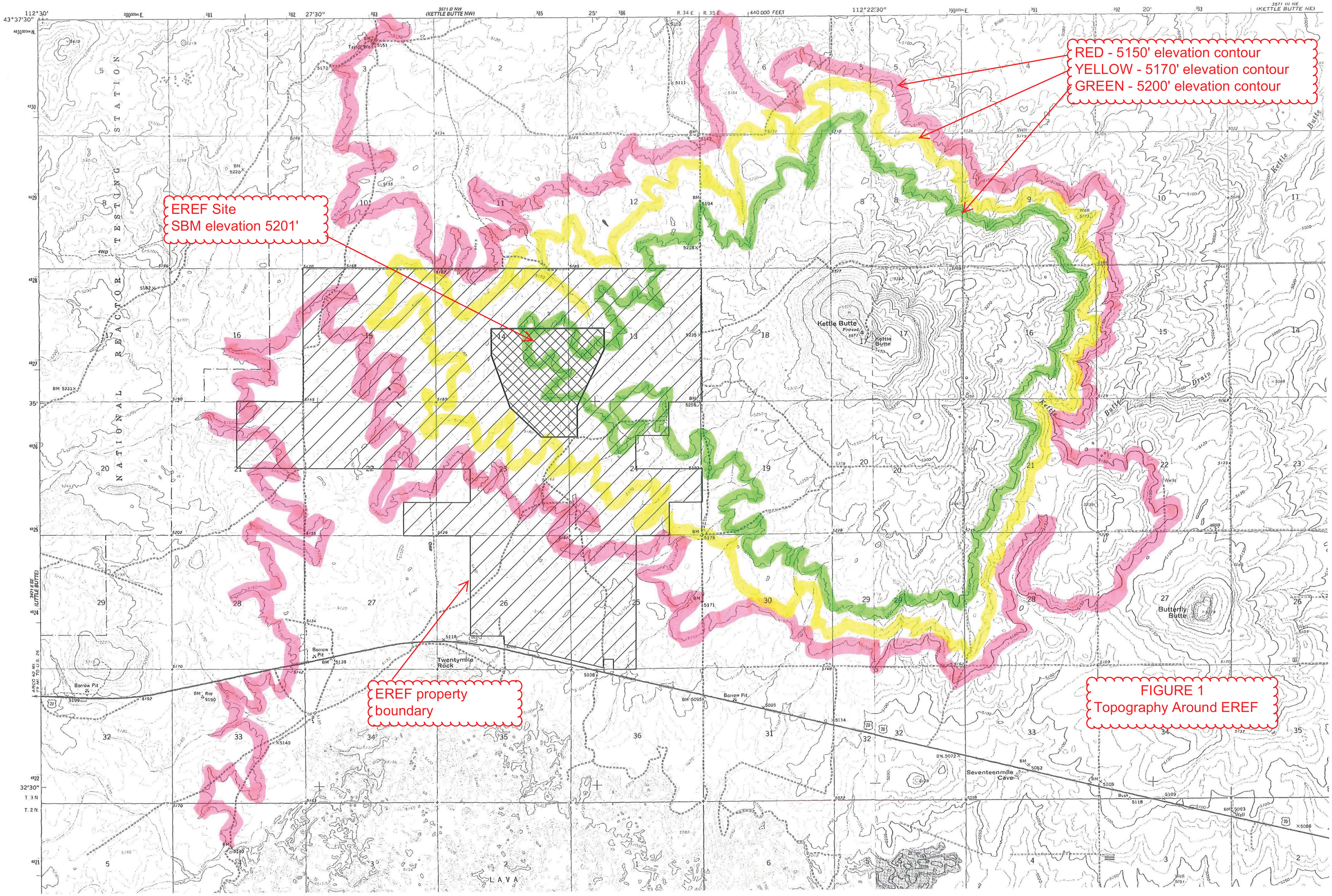
ASLB Question 27:

> **Please provide an explanation/justification as to why these appendices are considered official use only (OUO) information, particularly as they relate to accident sequences associated with natural phenomena (e.g., wildfires, earthquakes, or volcanoes).**

Response to Question 27 (Kay):

The appendices are considered OUO information because they are part of the Integrated Safety Analysis Summary ("ISA Summary"). The ISA Summary is considered Sensitive Unclassified Non-Safeguards Information ("SUNSI") material because of its sensitive nature.[9] The information in the ISA Summary was identified as SUNSI based on the guidance in NRC Regulatory Issue Summary ("RIS") 2005-31, "Control of Security- Related Sensitive Unclassified Non-Safeguards Information Handled by Individuals, Firms, and Entities Subject to NRC Regulation of the Use of Source, Byproduct, and Specific Nuclear Material" (ADAMS Accession No. ML053480073) (Exh. AES000056). Appendix D of the SAR is also used as Appendix D of the Environmental Report ("ER"). In the ER, this appendix is not withheld from public disclosure.

9 SUNSI means any information of which the loss, misuse, modification, or unauthorized access can reasonably be foreseen to harm the public interest, the commercial or financial interests of the entity or individual to whom the information pertains, the conduct of NRC and Federal programs, or the personal privacy of individuals. Under the NRC's internal procedures, SUNSI information is marked as Official Use Only ("OUO") information.


RED - 5150' elevation contour
YELLOW - 5170' elevation contour
GREEN - 5200' elevation contour
EREF Site
SBM elevation 5201'
EREF property
boundary
FIGURE 1
Topography Around EREF
Kettle Butte
Butterfly Butte
Twentymile Rock
Seventeenmile Cave
NATIONAL REACTOR TESTING STATION
LAVA